RHIC Program Review

9-11 July 2003

RHIC Experiments-Operations

Presented by

Philip Pile

C-AD Experimental Support and Facilities Division
9 July 2003

RHIC Experiments Operations

Outline

- Support for RHIC experiments – Approach
- Support for experiments - Work done / in progress/planned
  - FY2003
  - FY2004
  - FY2005+
- Final Comment

Experiment Support Details

- RHIC experiment support is a responsibility shared between the Physics, Chemistry and Collider-Accelerator Departments.
- The core infrastructure support for the experimental areas is provided by the C-AD Experimental Support and Facilities Division (ESFD).
- The RHIC polarimeters infrastructure support. The Si detector readout and DAQ are supported by Riken BNL Research Center (RBRC).
- Detector-specific experiment operations groups are maintained in the research departments and are responsible to build and maintain detectors.
  - BRAHMS, PHENIX, pp2pp and STAR operations groups are in the Physics Department
  - PHOBOS operations group are in the Chemistry Department.

Experiment Support Details (cont')

- The C-AD Experiment Support and Facilities Division is staffed to provide experiment as well as general C-AD support for AC power distribution, water systems, survey, mechanical and electrical services, physics and engineering liaison, communications (networking, television etc.)

- ESFD operational crews (CAS Watch) are maintained on a 24 hr basis, 7 days a week during RHIC operations and shutdowns to provide:
  - Safety surveillance of C-AD experimental areas and equipment
  - General support for experiment and accelerator operations

- ESFD is responsible for:
  - Safe installation and operation of experiments
  - Provide technical support for planning, costing and construction of experiments – C-AD resources are made available through Liaison Physicist and Engineer assigned to each experiment/proposal

Experiment Support Details (cont')

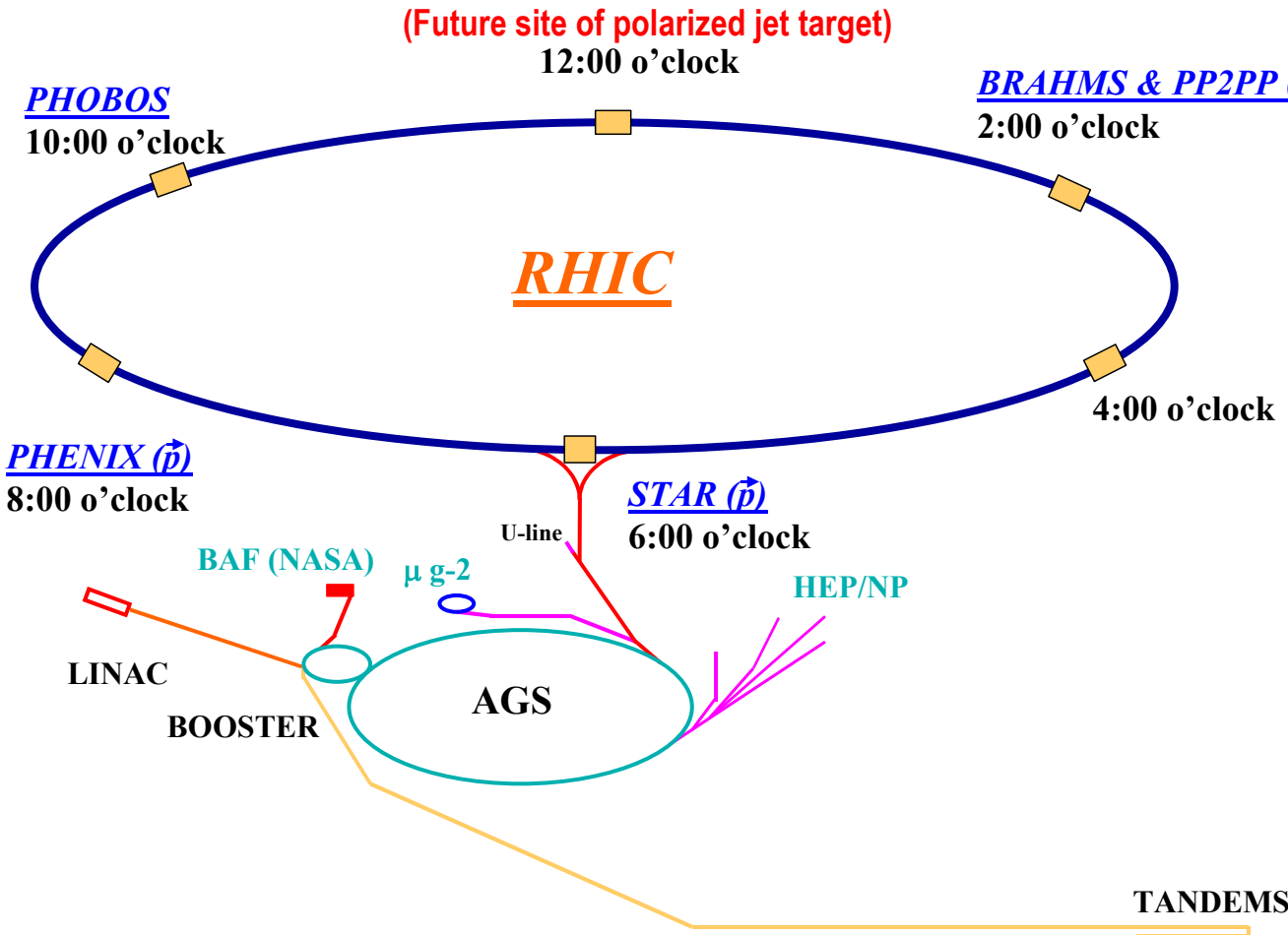
User Communications Meetings

- Year Round
  - Monday **"ES&F Division Staff Meeting"** - discussion with experiments and C-AD department management personnel re: work planned for the week. *Chaired by P. Pile*.
- During RHIC Operations
  - Monday **"Schedule Meeting"** between RHIC experiment representatives, RHIC run coordinator, and C-AD Experiment and Accelerator Division Heads and Scheduling Physicist to discuss/fix the schedule for the upcoming week. *Chaired by the Scheduling Physicist*
  - Tuesday **"Time Meeting"** of BNL personnel (key engineers, physicists, MCR operations personnel, C-AD management, Associate Lab Director for HE&NP, experimenters and others are held during RHIC operations to discuss schedule of collider operations (as well as AGS fixed target operations, if applicable), luminosity issues, any special problems operations personnel or experimenters may have etc. *Chaired by the Scheduling Physicist.*
  - Wednesday **"RHIC Machine/Detector Planning Meeting"** with experiments, attended by ALD for HE& NP, C-AD Department head, C-AD Division heads, RCF representative, experiment spokespersons and others. *Chaired by P. Pile*
  - Daily (as needed) **"RHIC Machine Status Accelerator Physicist Meeting"** - accomplishments/problems of previous 24 hrs, plan for next 24 hrs, experiment representatives welcomed. *Chaired by Accelerator Run Coordinator*

Experiment Support Details (cont')

- Support for experiments and projects not related to RHIC
  - ***During RHIC Operations, RHIC Experiments have first priority for support***
  - Work during maintenance periods (shutdowns) is scheduled in support of non-RHIC activities consistent with available resources once commitments to RHIC experiments and the RHIC facility are satisfied.
  - AGS Fixed target experiments are no longer supported concurrent with RHIC operations since HEP base support has terminated. AGS fixed target experiments are still supported but are scheduled to operate outside RHIC operations and only if this can be done with minimal impact to RHIC activities. Full operations costs are recovered. Two AGS experiments ran in this mode in FY2003 – NASA Radiobiology (E966) and Proton Radiography (E963).
  - The NASA Space Science Laboratory (NSRL), commissioned in FY2003, comes with full operations support and will be run stand-alone as well as concurrent with RHIC operations. The inaugural run is in progress (began 7 July). This facility uses beams extracted from the Booster.

C-AD Accelerator Complex



BRAHMS and pp2pp (2:00)

BRAHMS Experiment Support

FY2003

complete

- Ready for beam on 1 December 2002
- Upgrade firing circuits on spectrometer power supplies

in progress

- Roadway paving (GPP)
- Extend egress walkway over the mid rapidity arm

planned

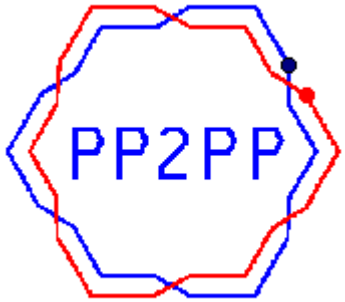
- * Experiment specific shielding upgrade
- Modify TOFWII Stand
- Seismic restraints for shield wall (planning/assessment of need)

* Capital Project

FY2004

- **Ready for beam on 15 November 2003**
- Seismic restraints for shield wall (1/2 years - Engineering)
- IR dehumidification
- Upgrade outside lighting
- Upgrade counting house

pp2pp Experiment Support



FY2003

- Completed fabrication of final 4 Roman Pots and detector support systems
- Supported installation of remaining 4 silicon detector systems
- Installed NMC detectors (for beam abort in event of beam loss on pots)
- Ready for beam April 2003
- Ran experiment 19-21 May 2003
- Experiment declared complete 10 June 2003

FY2004

- Nothing planned

PHENIX (8:00)

6/27/2003

PHENIX SHUTDOWN SCHEDULE SUMMARY - SD'03

PHENIX Experiment Support

FY2003

- Ready for beam 1 December 2002

In progress

- * Complete installation of humidity control/air conditioning system in IR
- Replace emergency exhaust louver
- Continue support for detector upgrades during FY 2003 shutdown
  - Shielding wall removal, detector roll-out
- Complete hookup central magnet inner coils and install power supply
- Add corrosion inhibitors to cooling water system

planned

- Seismic restraints for shield wall (planning/assessment of need)
- Modify emergency power system
- * Experiment specific shielding upgrade

* Capital Projects

PHENIX Experiment Support

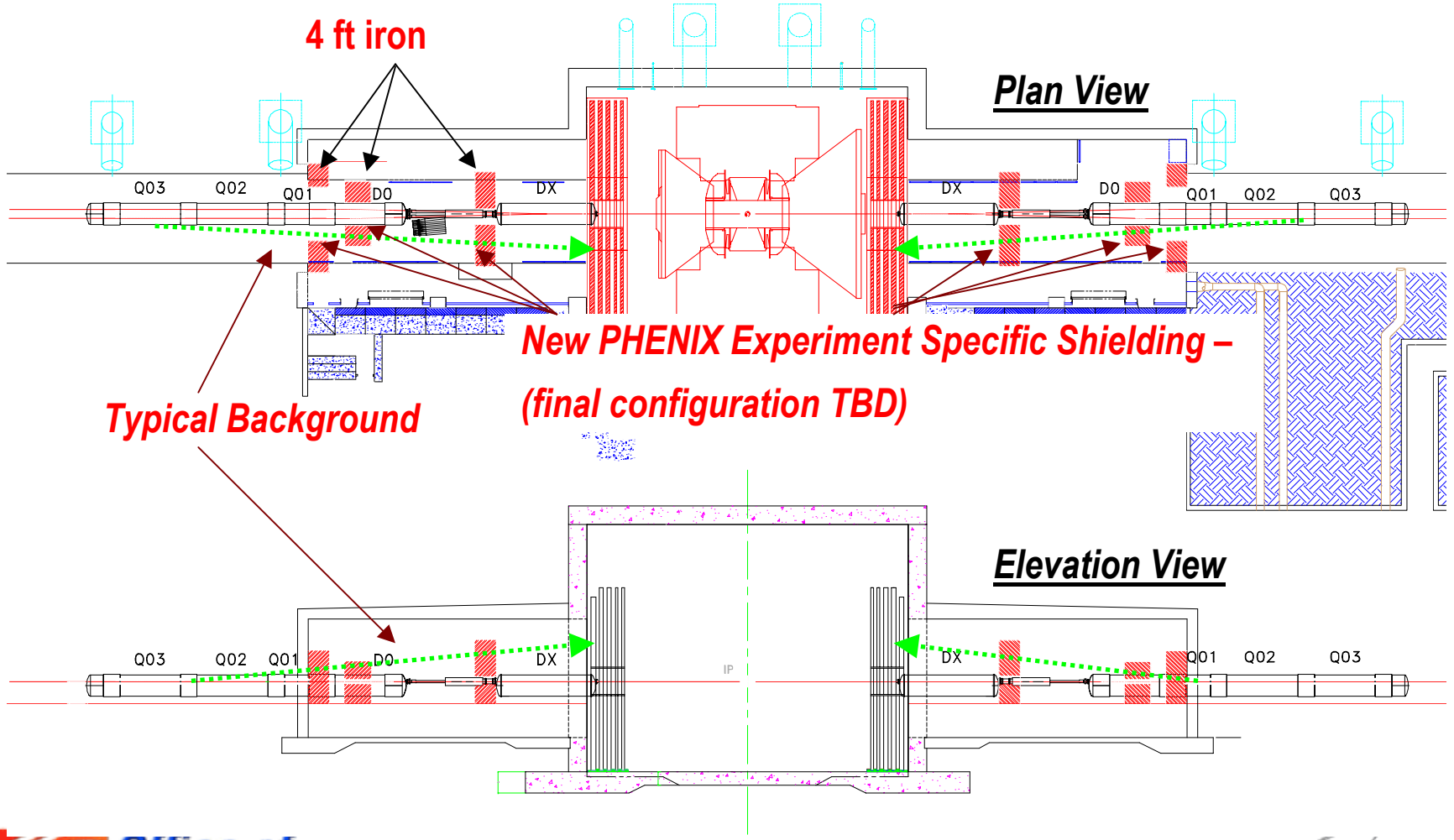
FY2004

- **Ready for beam by 15 November 2003**
- Provide heat for assembly building
- * Enhance 1008 standby power – additional emergency generator & modify distribution
- * Upgrade 1008A air conditioning – individual controls between DAQ and Control Room
- * Seismic restraints for shield wall (1/2 years - Engineering) – if needed
- Upgrade outside lighting
- Cooling tower sediment filters
- Paving to gas mixing house and storage areas (GPP)

* Capital projects

RHIC Experiment Shielding Working Group

Kin Yip (and others) work in progress



PHOBOS (10:00)

PHOBOS Experiment Support

FY2003

- Prior to FY 2003 run
  - Sextant 11 dehumidification upgrade
  - Installed west pcal detector
  - Service building ventilation upgrade

- Prior to FY 2004 run
  - Construct new SpecCal stand
  - Prepare and install east pcal detector & mini-pcals

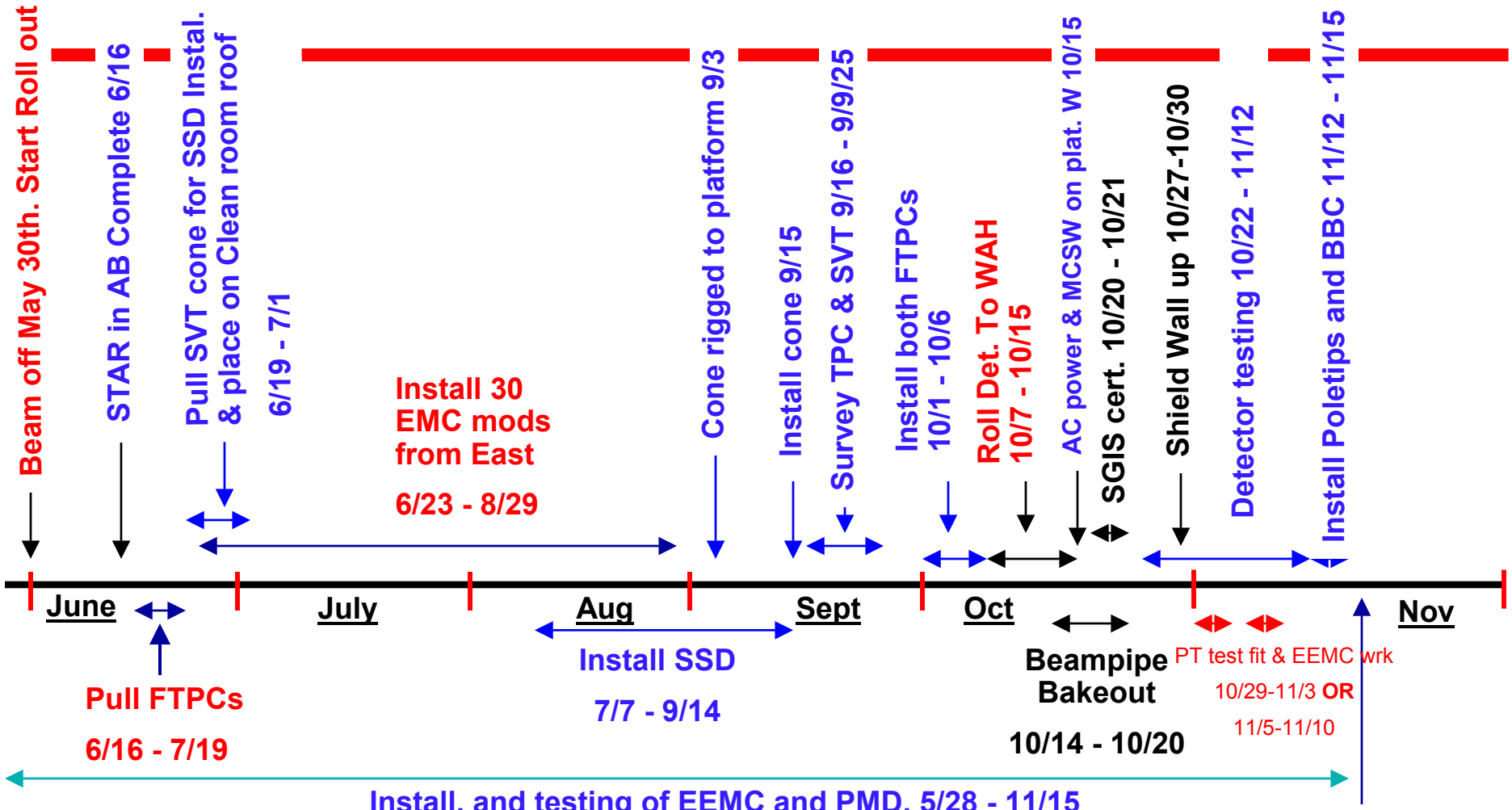
FY2004

- **Ready for beam by 15 November 2003**
- Upgrade outside lighting

STAR (6:00)

Summary STAR Schedule for FY03 Shutdown

Revised (6/24/03)



STAR Experiment Support

FY2003

- Reassemble the shield wall, ready for colliding beams by 1 December 2002

In progress

- Continue support for detector upgrade during FY 2003 shutdown
  - Shielding wall removal, detector roll-out *(complete)*
  - Added air cooled chiller to water system *(complete)*
  - Mechanical techs committed for entire shutdown period to assist with EMC (next to last year) & end cap calorimeter installation (last year)
- * Procure backup main power supply transformer
- Add corrosion inhibitors to cooling water system

planned

- Control room HVAC upgrade (drop ceiling)
- Seismic restraints for shield wall (planning/assessment of need)
- Ready for beam by 15 November 2003

* Special Process Spare

STAR Experiment Support

FY2004

- **Ready for beam by 15 November 2003**
- Tech support for completion of EMC installation
- * Upgrade STAR DAQ and control room air conditioning
- * Seismic restraints for shield wall (1/2 years - Engineering) – if needed
- Continue control room upgrade
- Cooling tower sediment filters
- * Add soft start to solenoid power supply
- * Bldg 1006 Crane Upgrade – variable speed drive
- Upgrade outside lighting

* Capital Projects

Polarized Jet Target (12:00)

$\vec{p}$Jet Target Experiment Support

Capital Project

FY2003

- Provide overall project coordination
- Conventional construction at the 12 o'clock area
- IR preparation, procure and install cable trays, electrical systems, and egress overpass; modify the emergency doors and move the vapor barrier; drill conduit feed through in the berm and shield wall, and provide an indoor counting house

FY2004

- Install jet target at 12 o'clock prior to polarized proton run (if scheduled)

The Polarized Jet Target Status & Plan (Y. Makdisi)

- Good progress but we are approximately a month behind compared to our "aggressive" plans of last January. Taking advantage of a 1 month delay in RHIC turn-on.
- Assemble and run the jet as a system in the jet lab this summer (2003)
- Complete the RHIC Safety Committee Review Late July
- Complete the construction in Service Building and IR by mid September
- Move jet into the IR in mid to late September
- Run Jet with remote systems in October
- Move jet to the lab in late October
- Restore the beam line for HI running by mid November
- Fine tune the Jet through March of `04 prior to reinstallation in RHIC
- Measure the absolute beam polarization to 10% in the first year with a final goal of 6%.

The Polarized Jet Target (Y. Makdisi)

Electronics racks

Vac. gauges monitors

Turbo pump controllers

Dissociator RF systems

Dissociator stage

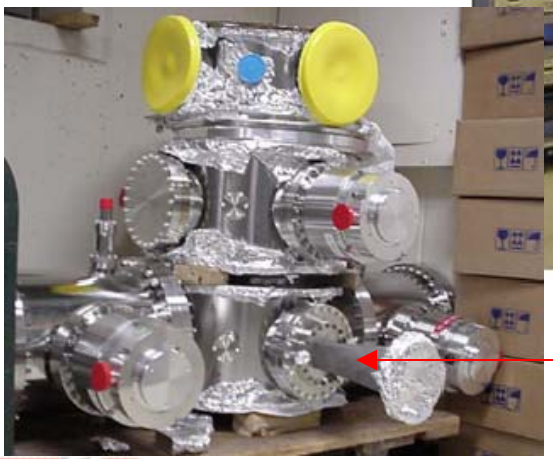
Baffle location

Sextupoles 1-4

Sextupoles 5-6

Profile measurement

BRP vacuum vessel

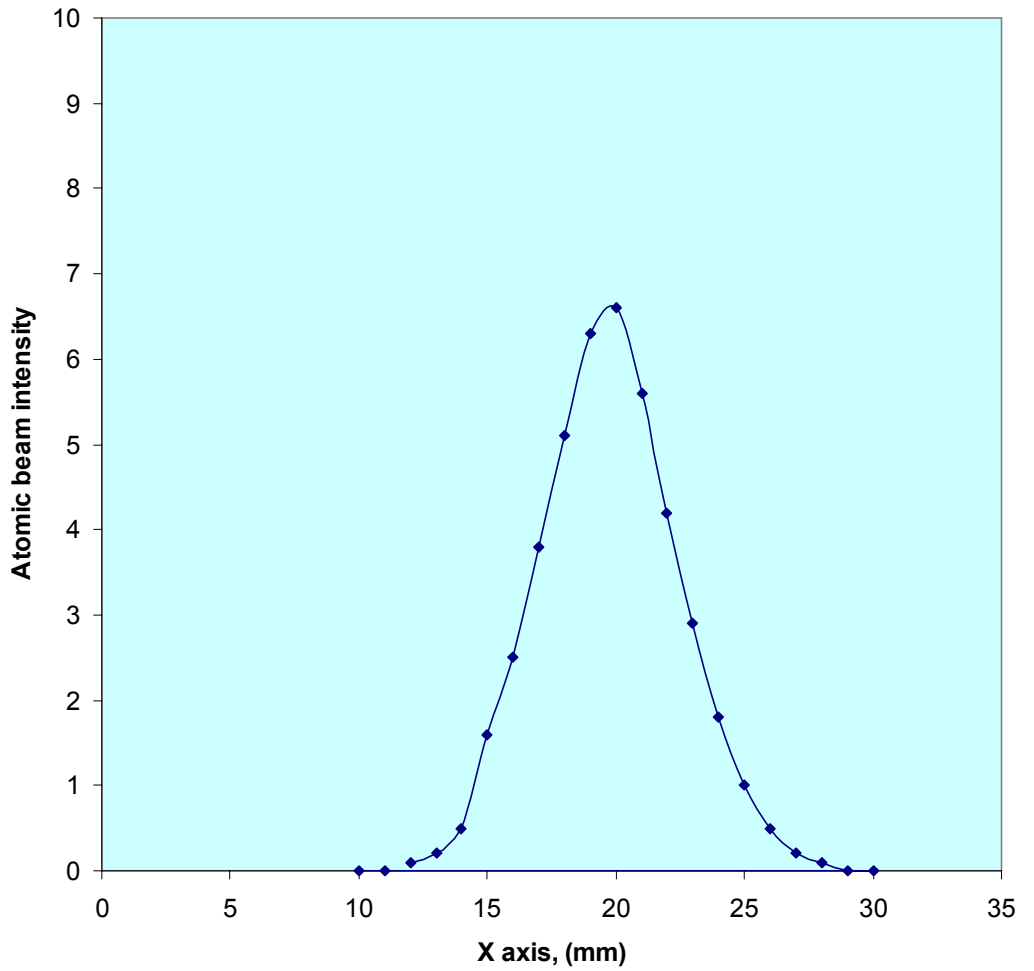


Target chamber &
beam pipe adapters

Magnet ready
for measurements

Office of Science
U.S. DEPARTMENT OF ENERGY

Hot From the Oven (Y. Makdisi)



- 7/2/03 the profile measurement. Accounting for the 2mm width of the compression tube, the FWHM of 4 mm is as expected.
- 7/6/03 measured the beam intensity at **5×10^{16} atoms/ sec** with a 9 mm compression tube.
- An estimate from the pressure rise gives 9×10^{16} atoms/sec.
- ***At 5- 9×10^{16} atoms/sec the jet is on par with the best existing ABS systems.***
- Work on optimizing the jet parameters continues.

RHIC Experiments Plans for (FY2005)

PHENIX

- Continue engineering and tech support for detector and facility upgrades, repairs etc.
- Convert cooling tower to ozone based system (GPP request)
- * Upgrade PHENIX electrical switchgear – remote monitoring of ground faults, loads, tripped breakers etc
- * PLC based safety system upgrade
- * Complete seismic restraint project

STAR

- Continue engineering and tech support for detector and facility upgrades, repairs etc.
- * Add 13.8 KV cross feeds (underground-overhead lines)
- * Electronics development trailer (to be outfitted with experiment funds)
- * Complete seismic restraint project
- * Enclosure between control room and 1006c addition
- Convert cooling tower to ozone based system (GPP request)

* Capital Projects

RHIC Experiments (FY2005)

BRAHMS

- * Complete seismic restraint project
- * Backup air conditioning unit for 1002C

PHOBOS, BRAHMS and RHIC Spin

- Power transmission line upgrade (GPP request, extend overhead transmission lines)

* Capital Project

C-AD Facilities (RHIC related)

FY2003

- Completed cryo reliquifier facility upgrades
- Completed cryo LN2 cooler facility work

In progress

- Berm stabilization and repairs
- Upgraded air conditioning for 4 RHIC alcoves
- Install piping to new RF/MG tower
- Upgraded AGS fire alarm system
- Upgraded RHIC cooling tower #7
- Provide power, tray, utilities etc for new AGS partial Snake
- ATR beam line water systems and magnet interlock systems upgrades
- Water system modifications to comply with Suffolk County Article 12
- Misc. GPP Projects

C-AD Facilities (RHIC related, out years)

FY2004

- Install RHIC Public Address system
- Complete upgrade of AGS fire alarm system
- Continue AC/ventilation upgrades to RHIC service buildings
- Permanent waterproof liner at H-10
- Berm stabilization and repairs
- Install external alcove building at 9 o'clock
- Add UPS's to alcoves
- Water system modifications to comply with Suffolk County Article 12
- Misc. GPP Projects
- RHIC e-cooling work:
  - Add power for RF system
  - Add cooling for RF system
  - Super conducting cavity installation

C-AD Facilities (RHIC related, out years)

FY2005-6

- Install additional external alcove buildings at selected locations
- Replace Linac cooling tower
- Replace cooling tower #1 (’06)
- Misc. GPP Projects

Final Comments

- ***Experiments have completed a third year of operations with heavy ion beams and the second year with polarized protons.***
- ***The ES&F Division works in partnership with the RHIC experiments and users (physics, engineering, technical, and training) in support of the physics program.***
- The ES&F Division is giving full support to the RHIC experiments during the FY 2003 shutdown period. Significant upgrades to the STAR and PHENIX detector systems are in progress.
- Upgrades and repairs to the facility in support of both accelerators and experiments continue.

RHIC Experiments Operations

Supplemental Material

C-A Experiments (as of July 2003)

RHIC Experiments

BRAHMS (HI)	BNL/Bucharest/Jagellonian/Johns Hopkins/Fysisk Inst – Bergen/Kansas/Oslo/U. Copenhagen/ NYU/Texas A&M	Broad RAnge Hadron Magnetic Spectrometers Experiment at RHIC
PHENIX (HI & PP)	ACU/Academia Secina/Alabama-Huntsville/Banaras Hindu U/BARC/BNL/CIAE/CAL-Seoul/DAPNIA/IPN-Orsay/Kangnung/LPC Clermont/LLR Palaiseau/Seoul National/SUBATECH/Columbia/CNS-Tokyo/FSU/GSU/Hiroshima/HEP-Protvino/ Iowa State/JINR-Dubna/KEK/Korea/Kurchatov Inst/Kyoto/LANL/ LLNL/Lund/McGill/ Muenster/Myong Ji/Nagasaki Inst. of Applied Science/UNM/New Mexico State/ORNL/PNPI/ RIKEN/ UC-Riverside/San Paolo/SUNY-SB/ Tennessee/Tokyo/Tokyo Inst. of Tech./Tsukuba/ Vanderbilt/Waseda/Weismann Inst/Yonsei	Pioneering High Energy Nuclear Interacting eXperiment
PP2PP (PP)#	BNL/INPCracow/Ecole Polytechnique/MEPHI Moscow/ITEP Moscow/INS Warsaw/Moscow Eng/SUNY Stony Brook/U. Texas Arlington	Total and Differential Cross Sections, and Pol. Effects in pp Elastic Scat. at RHIC
PHOBOS (HI)	ANL/BNL/INP-Krakow/U.Krakow/MIT/NCU-Taiwan/U.Rochester/U. Ill-Chicago/ UM	An experiment to detect rare and unusual events (named for a moon of Mars)
STAR (HI & PP)	ANL/Beijing/Birmingham/Bhubaneswar/CALTECH/BNL/UC-Davis/UCLA/CMU/Creighton/ Dubna/ Frankfurt/IU/IreS/Kent State/LBL/ Max Planck/MSU/Moscow Engr/NPI AS CR/Lanzhou/Jammu/NIKHEF/Indian Inst/Panjab/Rajasthan/Science & Tech China/Shangshi INR/Texas A&M/ CCNY/OSU/PSU/Protvino/Purdue/Rice/San Paulo/SSL/SUBATECH/UT-Austin/Tsinghua/Valparaiso/Kolkata/Warsaw U Tech/UW/Wayne S/Wuhan/Yale/Zagreb	Solenoidal Tracker At RHIC

AGS Experiments

E926 SEB	BNL/INR-Moscow/UBC/U.Cincinnati/Kyoto U/U. New Mex/USB/Perugia/TJNAF/TRIUMF/Va. Poly/U. Va./Yale/U. Zurich	Measurement of $K^{o}_{L}\rightarrow\pi^{o}\nu\nu$
E927 SEB	BNL/UCLA/JINR/ACU/ANL/Az.U/Boskov/U.Colo/GWU/U.Karlsruhe/Kent/PNPI/ Regina/ Valparaiso	Measurement of the K^{+}_{e3} decay rate and spectrum
E930 SEB	BNL/Hampton/KEK/NCA&T/Osaka/Tohoku/U.Tokyo	High-resolution γ spectroscopy of hypernuclei using large acceptance germanium detector
E931 SEB#	Ariz/BNL/Carnegi-Mellon/CEBAF/C.Newport/ Colo/GWU/Houston/Kentucy/ LANL/La.Tech/ MD/MN/ NC A&T/Boskovic Inst/Texas-Austin/Tohoku U/UCLA/U.Zagreb	Study of the $\Delta I=1/2$ rule in the weak decay of S-shell hypernuclei
E940 SEB	Boston U/BNL/UC-Irvine/Houston/INR-Moscow/U. Mass-Amherst/NYU/Penn St/Purdue/Syracuse U./College Wm.Mary	Search for $\mu N\rightarrow e^{-}N$ with sensitivity below 10^{-16}
E949 SEB	BNL/Ctr. For Subatomic Research –U.Alberta/FNAL/Fukui U/IHEP/INR-Moscow/JAERI/KEK/Natl. Def. Ac. of Japan/U. New Mexico/Osaka U/RCNP-Osaka/TRIUMF	An experiment to measure the branching ratio B ($K^{+}\rightarrow\pi^{+}\nu\ \nu$)
E951 FEB	ANL/BNL/CERN/FNL/LBNL/ORNL/Princeton U-J.H.Lab/SUNY Stony Brook	An R&D Program for Targetry and Capture at a Muon-Collider Source
E945C FEB*	BNL/LANL	Cryogenic Thermal Spike Exp. to run with Proton Radiography
E952 SEB	Boston U/BNL/NYU/Cornell/U. Heidelberg/U. Illinois/U. Mn/Yale	An Improved Limit on the Muon Neutrino Mass from Pion Decay in Flight
E953 SEB	Abilene Christian U/ANL/Ariz/G. Wash.U/Kent/PNPI/Rudjer Boskovic/UCLA/U.Colo/U.Karlsruhe/U.Md/U. Uppsala/Valparaiso	Neutral Hyperon Spectroscopy with the Crystal Ball
E962 FEB	Boston/BNL/BINP/Cornell/Fairfield/Heidelberg/Ill/LBL/LANL/ M.Planck/ MN/KEK/Riken/ Tokyo/Yale	A Precision Measurement of the Muon –g-2) Value
E963 FEB#	Bechtal/LLNL/LANL	Proton Radiography at the AGS
E964 SEB	Gifu U/Kyoto U/Tohoku U./China Institute og Atomic Energy/Osaka City/Pusan National/Tokyo/BNL/CMU/UNM	Systematic Study of Double Strangeness System by an Emulsion Counter Hybrid Method
E965 SEB*	BNL/UCLA/Texas/Zurich/Hawaii/Napoli/Pisa/Princeton	Proposal to Measure tihe Efficiency of Electron Charge Sigh Determination up to 10 GeV in a Magnetized Liquid Argon Detector (μLANND)
E966 NASA#	Alabama A&M/BNL/Case Western Reserve U/Colo U/Columbia U/John Hopkins Med. Inst/LBL/LANL/PNNL/Texas A&M U/U. Md/WSU	NASA Radiobiology

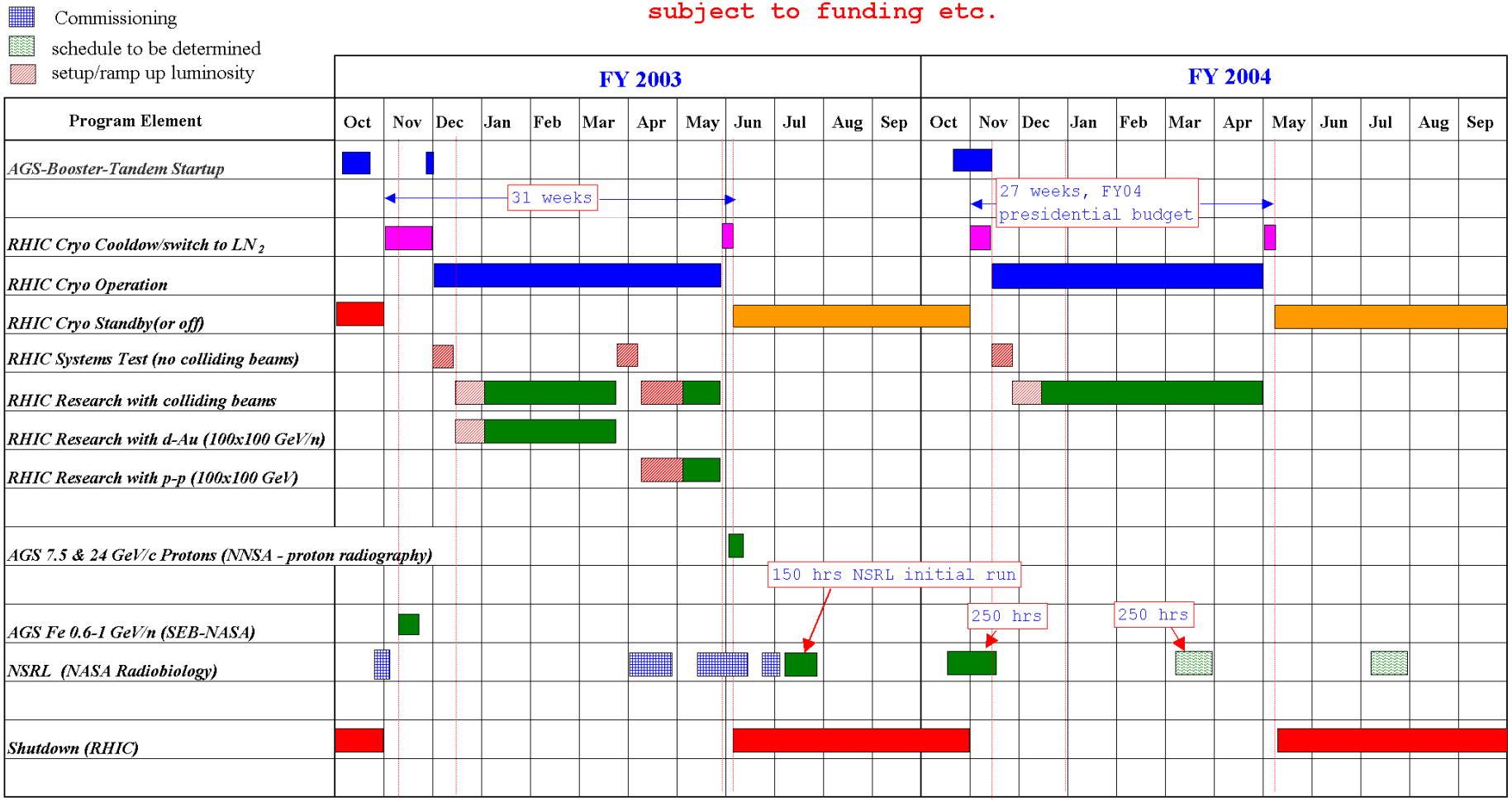
SEB-Slow Extracted Beam – Protons PP- Polarized Protons; NASA-0.6-1 GeV/c/nucleon Fe; FEB-Fast Extracted Beam, Protons
Completed in FY2003; * Proposal

http://server.c-ad.bnl.gov/esfd

C-A Operations-FY03-04

27 June 03

subject to funding etc.



http://server.c-ad.bnl.gov/esfd

- Normal running
- Concurrent with RHIC operations
- Schedule to be determined
- Engineering/Commissioning
- Standby
- RHIC development with colliding beams

C-A as run schedule, fy2003

By: A. Rusek/P. Pile Date: 27 June 03

FY03

Beam	Exp #	Experiment Spokespersons or Activity	Charged Hours	Approved Hours
		RHIC Beam/Mode		
		AGS Beam Mode		
		Tandem/Booster/AGS Startup		
		RHIC Cryo Startup/RHIC Systems Tests/warmup		
		RHIC Cryo on		
		RHIC Cryo off		
		BLIP	1438	
		RHIC Studies (AsRequired)		
		AGS pp studies		
		NSRL (Booster)		
RHIC Experiments				
100 x 100 GeV/n d-Au				
6:00	STAR	Hallman	566	-
8:00	PHENIX	Zajc	546	-
10:00	PHOBOS	Busza	497	-
2:00	BRAHMS	Videbaek	505	-
100 x 100 GeV pp				
6:00	STAR	RHIC Spin	192	-
8:00	PHENIX	RHIC Spin	202	-
10:00	PHOBOS	Busza	138	-
2:00	BRAHMS	Videbaek	109	-
2:00	PP2PP	Guryn	33	40
AGS Experiments				
A3	966	Vazquez	183	200
U	963	Morris	173	-
Unscheduled AGS Experiments				
A3	951	McDonald	165	3600
B5	940	Molzon	4	4000
C2	953	Manley/Spinka/Nefkens	0	450
C2	927	Nefkens/Comfort	233	2280
C3	926	Bryman/Littenberg/Zeller	272	8000
C4	949	Bryman/Kettell/Sugimoto	2402	6000
D6	930	Tamura	1002	1428
D6	961	Fukuda/Rusek/Chrien	0	1200
D6	964	Imai/Nakazawa/Tamura	0	1400
V1	952	Cushman	56	
V1	962	Hughes/Roberts/Morris	0	2000
Proposed AGS Experiments				
A3	965	McDonald	0	100
U	945C	Greene	0	
LOI AGS Experiments				
D6	MRS	May		
V1	EDM	Miller/Semertzidis		
NEW	√s	Diwan		

RHIC Beam/Mode	S	d & Au	pp	S
AGS Beam Mode	S	d/Au Fe	pp	p S
Sep	3 9 17 24			
Oct	1 8 15 22 29			
Nov	5 12 19 26			
Dec	3 9 17 24 31			
Jan	7 14 21 28			
Feb	4 11 18 25			
Mar	4 11 18 25			
Apr	1 8 15 22 29			
May	6 13 20 27			
Jun	3 9 17 24			
Jul	1 8 15 22 29			
Aug	5 12 19 26			
Sep	2 9 18 25 30			

energy curtailment

Legend

S	Scheduled Shutdown
Au	Gold beam
Au	Gold beam
p	proton beam
d	deuterons
pp	polarized protons